Building open bridges: collaborative remixing and reuse of open educational resources across organisations

Conference or Workshop Item

Building Open Bridges: Collaborative Remixing and Reuse of Open Educational Resources across Organisations

Tim Coughlan
Horizon Digital Economy Research
University of Nottingham, UK
tim.coughlan@nottingham.ac.uk

Rebecca Pitt
Institute of Educational Technology
The Open University, UK
r.e.pitt@open.ac.uk

Patrick McAndrew
Institute of Educational Technology
The Open University, UK
patrick.mcandrew@open.ac.uk

ABSTRACT
In this paper we analyse the remixing and reuse of online learning materials offered as Open Educational Resources (OER). We explore the practices that developed as a set of course materials were released as OER from the UK, remixed for a US context by a cross-organisational, cross-cultural team, and then reused in a broad range of educational settings. We analyse the approaches taken during these remixing and reuse activities as novel forms of creative collaboration. As a basis for comparison, we explore similarities and differences with other Open practices. We identify how openness provoked novel inter-organisational collaboration and forms of ownership; define forms of open practice that need support, and present issues that should be considered in devising and supporting open projects in education and beyond.

Author Keywords
Open; Education; OER; Collaboration;

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION
Open practices in education are felt by many experts to be essential to changing the way we learn to meet 21st century challenges [1,14,27,28], yet the interactions around these practices have been little studied to date. Open Education Resources (OERs) are a central component in these practices. These are teaching, learning and research resources that reside in the public domain, or have been released under an intellectual property license that permits their use and re-purposing by others [1].

Openness has had a recognised impact in open source software development [4,7,18,21,29] and online creativity [2,5,13]. However other forms of openness are emerging, and understanding of these is limited. Open approaches are also evolving and integrating with broader forms of knowledge work in organisations [4,21]. To broaden understanding, we present an in-depth case study of innovative collaborative practices around the remixing and reuse of OER. We study an initiative that took materials originally devised as an introduction to entering higher education at a UK-based university, and collaboratively remixed them for reuse across a broad US audience. One UK-based and three US-based organisations worked to remix the content, and more than 16 diverse educational institutions have since been involved in reusing it.

A research team was embedded in the initiative, and we draw upon a large set of documents, interviews, communications and observational data to explore the practices and experiences of those involved. Our contribution is to develop broader understanding of collaborative interactions around openness, as the concept proliferates and evolves through the development of practices across organisations. Key research questions are: How do the issues raised around OER relate to other domains where openness has been studied? How do projects based around openness integrate with organisational cultures? More specifically, what practices develop, and where are the challenges in supporting OER remixing and reuse for educational establishments?

BACKGROUND
In this section, we review the concept of Openness, and give a background to its application in education. We then discuss how creative collaboration provides a lens through which to understand remixing and reuse of materials.

Interactions around Openness
The concept of Openness has proliferated across domains from roots in software and academia. In response to diverse uses of the term, efforts have been made to maintain a strong definition by the Open Knowledge Foundation. This states that "A piece of content or data is open if anyone is free to use, reuse, and redistribute it – subject only, at most, to the requirement to attribute and / or share-alike" [20]. While the concept is not bound to technology, it has emerged to prominence through the ability of digital objects to be shared without being lost [10]. Practically, openness is defined in terms of licensing works for distribution, and supporting their reuse as widely as possible. The concept is

CHI'13, April 27 – May 2, 2013, Paris, France.

being applied in a wide range of domains, such as open data [26] open hardware [15,16] and open publishing models [27]. However, the major focus for research in HCI and CSCW to date has been open source software (OSS) development, which represents the most mature form of openness. A further theme has been structures for loose collaboration, providing the basis for 'commons-based peer production' (CBPP) such as Wikipedia and ccMixter [2,5].

In its commonly understood form, OSS provides a contrast to commercial software development, in that it is created by partly voluntary, geographically dispersed communities. It has been a remarkable success, producing building blocks of modern computing such as Apache and Linux. Yamauchi et al. found that OSS development is biased towards spontaneous action by individuals, rather than relying on the strong coordinated planning expected in commercial development [29]. Gutwin et al. found however that both general awareness of on-going work, and specific awareness of relevant people, was maintained in OSS communities through mailing lists and text chat [7].

While OSS and CBPP often involve large numbers of independent people loosely working together, approaches to open collaboration do not always take this form. Luther et al contrast OSS development with 'collabs' – small online group projects to create animated movies. In these, planning, strong leadership and consistent communication were essential to success [13]. Mellis and Buechley studied open source hardware development around the Arduino platform, finding that the different characteristics of the product changed the nature of open collaboration. The constraints of manufacturing a physical object led to less tinkering or spontaneous work, and a focus on agreement towards investment in a specific new design by small groups [15]. Even within OSS, distinctions between user interface design and more technical work were drawn from Moghaddam et al., who studied a corpus of discussion data and conducted interviews in the Drupal and Ubuntu communities. They found UI discussions lengthier and more subjective in nature. There was often difficulty in producing supporting evidence for UI designs, and using processes designed for technical development work [18].

As openness proliferates it interacts with other organisational models and working practices. In computing this can be seen as commercial giants such as Sun, IBM, and Microsoft work with OSS communities (e.g. [17]). Surveying OSS research, Crowston et al. found limited understanding of the practices through which firms are involved with OSS, but at the same time, studies suggested that as many as 45% of contributors to OSS projects were paid by companies to do so [4]. Rolandsson et al. found that integrations of open source had significantly affected programmers working in 'hybrid' commercial organisations and SMEs built around OSS, as they dealt with tensions between the open and proprietary approaches now combined in their work. They found themselves obliged to contribute to value creation outside the firm, and to manage differences between the logic of the firm and of open source communities. Overall, they find this *"may enable individuals to improvise and innovate in their daily work, but their professional strategies will still be conditioned by the organizational context in which they work"* [21].

Openness can also be seen to be provoking complex changes in research collaborations and cultures. For example Vertesi and Dourish contrast data sharing cultures in two large-scale, long-term space exploration projects. While one project collects and shares data in an open, interdependent culture, the imposition of an open approach to data sharing in another project was internally divisive and contrary to existing processes. Here, independent sub-teams within the project had strongly protected their own data until fully analysed, both to avoid misinterpretation and to prevent 'scoops' by others [26]. However, open data and open access to publications are both argued to hold benefits for research in general. For example there is evidence that citation rates for open access articles are higher than for those requiring payment [27].

Open Educational Practices

Although OER has a shorter history than OSS, and could be said to be at an earlier stage in its development, it is a rapidly growing area of educational practice and research. Reviewing the movement in 2007, Atkins et al. describe a *"possible perfect storm of innovation in discovery and learning"*. Greater demand for access to education, coupled with a shortage of places and high costs are a major worldwide problem that open education can help to solve [1]. Open approaches can support lifelong learning practices, where individuals can balance the needs of work and responsibilities with the continual learning needed in a changing world [14]. As resources are online, open approaches are often linked to distanced learning. However they can also be integrated with face to face teaching, with a study showing that hybrid courses combining open materials with traditional instruction accelerated learning, with equal or better results for students achieved in half as much time as traditional university teaching [11].

Early examples of OER were often provided 'as is' from the context they were devised for. However in making these resources relevant to the needs of different audiences, there is a desire to encourage new 'Open Educational Practices', defined as *"the set of activities and support around the creation, use and repurposing of Open Educational Resources…(and) the contextual settings within which these practices occur"* [3]. Wiley argues that while the use of OER is often conceptualised as 'assembly' - combining resources as if Lego bricks for reuse with a new audience - open licences allow for more fine-grained modifications to be made through 'remixing' OER. To date, the potential for remix and reuse practices are little understood, poorly supported, and yet to occur in a widespread fashion [28].

Like OSS, a leading role is being played by academia. Unlike OSS, large projects are funded by philanthropic organisations, and open education is more fundamentally connected to the core work of academia – teaching and scholarship. Like the companies and SMEs studied by Rolandsson et al. [21], new organisations are forming that integrate OER and open practices, and existing institutions are exploring ways to work with OER. Massively Open Online Courses (MOOCs) are a popular form of OEP where resources from around the web are aggregated, remixed, repurposed and shared by students and leaders in semi-structured courses [9]. These courses can also be linked to formal assessment, and open forms of assessment are being explored, e.g. Mozilla Open Badges [19]. A concern is that these approaches are only suited to digitally literate, independent learners [9], and so far this is backed up by demographics of those taking part in MOOCs [8]. Different kinds of practices around OER appear necessary to address the needs of learners at earlier stages in their development.

Aside from reducing costs, open practices can be seen as a means to increase the quality of texts for students, through collaboration amongst experts, and a means for curriculum to be discussed and standardised [25]. However, in studying perceptions of a nascent OER project to create a health education program across organisations in developed and developing countries, Luo et al. found a lack of institutional incentives, technological skills required to use online tools, or available time to develop them, as major barriers for the instructors involved. However, they highlight the potential for *"cross-role, cross-institutional collaboration"* around OER in sharing resources and practices. In response they argue that OER production and publishing infrastructures need to be developed within each organisation, extending Olson et al.'s work to suggest the need for *"institutional dimensions of collaboration readiness"* [12]. In this paper we analyse the results of this type of collaboration in a mature initiative, and explore the practices and phenomena that emerge.

Remixing and Reuse as Creative Collaboration

Practices such as remixing can be seen as emerging forms of creative collaboration facilitated by openness. Lessig argues that legal actions around copyright have become stifling to creative work, and therefore clarification of the scope of property, and a strengthening of the concept of 'the commons' online is necessary. The development of Creative Commons as a legal framework for sharing is a response to this [10]. The concept of remixing – directly altering other creative works - has become a strong theme in openness across domains, as Creative Commons has made this legally legitimate. For example Chelotis and Yew analyse the users of ccMixter – one of the first sites to use Creative Commons licences as a basis for CBPP of music. Amongst the population, they find that a consistent core of users build reciprocal ties by remixing each other's content, while others join in only for one off events [2].

Diakopoulos et al. argue that authorship becomes a complex construct in remix cultures, incorporating originality, authority, intertextuality and attribution [5]. Even where a creation may be considered as the work of a single person, collaboration is essential in most creative tasks. Open practices can also provoke cross-cultural knowledge sharing [12], which has often been seen to inspire creativity, for example the influence of African art on Picasso and Matisse [5]. Group creativity needs to be understood as a process in which intersubjectivity plays a key role, as a process of *"shared-meaning making"* between those involved [22,23].

In traditional conceptions of creativity, there is a clear delineation between creators and audience, with 'backstage' work not visible in the final product or performance [23]. An important factor in OSS is the provision of source code, rather than just a compiled piece of software. This supports the evolution of code, essentially by making the backstage work more visible. In other forms of openness, there may not be a direct analogy to source code, but efforts are expected to make the modification of knowledge as easy as possible [20]. For instance Mellis and Buechley find that an open hardware project that provides the design and parts for an FM radio allows participants *"to focus their creativity on those aspects of most importance to them"* [16]. It is clear that open products can provide a platform for further work with efficiency and known quality. Equally, OER could provide something similar to what Stokes defines as a *"first chorus"* - a reference to prior work, which is applied in directing new creative processes [24].

A CASE STUDY IN REMIXING AND REUSE OF OER

The *Bridge to Success* initiative involved collaboration between a large US-based community college (hereafter referred to as A), a US-based public university (B), a UK-based university (C) and with support and guidance from a further US-based private research university (D). The aim was to take two existing distance-learning courses on mathematics and study skills, written in the UK and released as OER after several years of use, and to remix these for a US audience. As these were introductory higher education courses, the aim was to promote their reuse to increase enrolment, retention and completion of college courses. The core team involved comprised around 20 people. Of this, 11 spent at least part of their time teaching students, and had used, or would use, the materials directly in their work. The rest were managers, editors, technical staff and educational academics.

Data Collection

A research component was embedded into the project, with the aims of both understanding best practice in remixing and assessing the impact of the materials through reuse. Three sets of semi-structured interviews with team members were conducted at the beginning, middle and end of the remixing processes (see table 1). Research team

members also attended meetings across project work packages. Further sources of data included copies of shared documents with tracked changes, used in the process of remixing. Researchers were also copied into email exchanges. A parallel work package studied reuse: Interviews and observations were conducted with instructors and learners from a range of the institutions that have used the materials, alongside online surveys for both instructors and learners, and logging of site usage.

Interview Set	Participants
UK project 'kick-off' meeting (June 2011)	2 from A, 2 from B, 5 from C.
Mid-project US meeting (Sept 2011)	6 from A, 3 from B, 8 from C, 2 from D
Post-remix UK / US interviews (Feb / Mar 2012)	2 from A, 4 from B, 4 from C.

Table 1: Interviews with remix team members over the project

Analysis

Interviews, observation notes and recordings of meetings were analysed and coded thematically. Two researchers with distinct backgrounds - HCI and philosophy / education - were involved in this process and initially explored the data independently, developed codes and defined themes of interest with interview data, before coming together to compare and build a shared set of themes through which to explore the rest of the data. A broader research team including members from all four collaborating organisations were involved in discussions of the data.

FINDINGS

In the following sections, we explore the motivations of those involved in the project, and then analyse interactions around the remixing and reuse of the materials.

Motivations and Benefits

The choice of courses reflected areas where team members perceived that materials could have great impact. A participant from B stated that *"something that is independent of any particular culture is…human behaviour and human attitudes towards mathematics"*. However there was clear awareness that cultural differences needed to be bridged. A participant from C, states that: *"There are similarities between the situation in the US and the UK, in that we've got a lot of people who are frightened of maths, think they can't do it…but the approach to teaching maths in the two countries is quite different, so we've had quite a lot of fruitful discussions about those differences*".

As an online, freely available resource, the materials were expected to be a particularly important supplement for college students, both those who were struggling with particular concepts, and those who needed flexibility due to commitments such as family and work. There was confidence that tried and tested materials from one culture could be adapted for another with less work than would be necessary to create entirely new resources, and with higher resulting quality. Later in the project, team members confirmed that they still maintained this position.

Learning from Each Other

When asked what would be learnt through the project, new interactions with those working in other institutions and cultures were a common theme. A participant from D summed up this by saying that *"the whole philosophy for Open is that you can share solutions, you can share strategies, and I am seeing that happen"*. Cross-cultural sharing was also expected to have strong benefits, with a participant from A noting that: *"it is really intriguing to me to see the different approaches from the different sides of the earth, that we are able to take our experience and the things we have done and put them together with a fresh perspective"*. A participant from C stated that *"It's been tremendously interesting to work with (employees from A) and see their approach to maths"*.

Learning was driven by addressing the goal of creating a remix, but could occur more serendipitously. For example a participant from A stated that *"initially we were so intent on just making sure that we had a solution…concrete steps. But we've learnt so much along the way that I think has really made this a very rich, rewarding experience for all of us*". A participant from C described how *"I've spoken to two teachers today, who have blind students in their classrooms…studying science. Now that is key to a project that I'm working on, (at C). Being able to understand the difficulties their students have had with their virtual environments helps. So I can take back some of their expertise"*. This also highlights how understanding was usefully shared about diverse user groups, provoked by the open collaboration. A further theme was how the project marked a shift outside of normal work, e.g. *"my role at (C) has been very institutionally focused, and it is for me personally really exciting to be working on a global project"*. In addition, most team members had not used OER before, and saw this as an opportunity to learn.

Organisational Benefits

There was a strong perception that openness presents opportunities for educational organisations. C and D were already involved in releasing course materials prior to this initiative. The availability of grants from philanthropic organisations has combined with evidence that openness can positively affect student recruitment to make OER projects attractive and accepted strategically [1]. While they still produce learning resources, these organisations have assessed that the resources themselves are not a central product in their business model, but a part to which value can be added through openness. Parallels can be seen in the computing industry, in both cases, business models are

evolving, and open approaches can be part of staying ahead of the curve.

For B, there was a sense that the cross-cultural nature of the project linked well with their global presence, e.g. stating that: *"the global perspective is something that we have been aiming for… we have students all over the world. (but) it is a different perspective to know that we are taking (content) originally developed for non-American students"*. Team members from A expected that the project could lead to organisational changes in approach to difficult issues e.g. *"I'm really hoping that it does change some policy…(for example) right now they do take a placement test (on arrival) whereas, we might be saying, 'well don't take a placement test for a minute, if you can hold off, take (the remixed course), and then hopefully when you do take placement you'll place higher"*. In an early meeting, a team member from A described how the project would be valuable to their innovation of approaches to teaching, stating that: *"We were teaching from textbooks, we don't have our* ***own*** *materials"* (until now). Building ownership and control over the learning resources was seen as key in tackling the challenges team members faced as educators, showing the importance of OER practices that go beyond the simplistic 'assembly' of existing materials.

Remixing

Although open resources can potentially be subject to continuous change, the initiative contained specific periods that can be considered 'complete' remix processes. These began with an original version and were completed when a new version was published online. The study skills course was revised over three months by a small group, with one content expert and an editor from B working with a production team at C. In contrast, the mathematics course was subject to a nine month process of remixing, with extensive involvement from ten content experts across institutions A, B and C, two editors, and production and technical work occurring across institutions A and C. Because of its richness, we focus on the mathematics remix, and use the study skills remix to contrast approaches.

Developing the Collaboration

The remixing process for the mathematics course involved extensive cross-organisational collaboration. A large portion of the creation and editing of content was performed by two instructors from A, with a further three people involved in this role. Weekly online meetings were originally led by the lead author of the original course at C, and later by a professor from B. Two other content experts also reviewed and discussed changes. Two editors at B worked on checking and formatting content for publishing. The technical team comprised two people working at C, and a further two at A, trained as part of the project to use C's systems to add and edit content. Five people were directly involved in management roles and many others were involved less directly. To varying degrees, all combined this with other responsibilities outside of the project, with some only involved for short periods.

The project included a large planning and management component from the beginning, in contrast to approaches seen in OSS. Throughout the project it was necessary to adapt plans, get more people involved at each institution, and push for deadlines to be kept, as organisations had already planned for use of the courses with scheduled classes. Face to face meetings of a subset of team members occurred in the UK in June 2011 and the US in September 2011. These were considered important for planning and for building relationships, with a member of B stating that *"it's very clear talking to (people from C), how much they care about the student… that really came through ...Initially we seemed to have different objectives, but actually not"*.

Procedures were often adapted from precedents within the organisations. An early discussion defined two instructors from A as main *"authors"*, with the others forming a *"review team"*, to give comments and debate decisions if necessary. A review team member from C describes the role as going "*through it critically, looking for things like continuity, where things have been moved, checking that the level is still appropriate"*. This was largely adapted from processes used at C (the original authors of the materials), although in this instance the team was larger, and distinctions between author and reviewer roles looser, with reviewers making contributions alongside the authors. The approach was time consuming, but in aiming to take account of multiple perspectives and maintain quality it was considered necessary. The leader of the review team from C stated during the first meeting that *"I guess you are getting a feeling now for just how long this kind of reviewing takes, so if anybody has ideas about how we could do this differently, please say"*. There were disagreements over changes throughout the process, and several team members noted difficulty in distinguishing between issues based in UK / US cultural differences, as opposed to personal beliefs in particular pedagogical approaches. In response, the team agreed an approach to decision-making where, as a team member from C explains: *"it was a right…if two people object, their names are on this project…it's not going to be suitable"*. This rule was applied by different members, and encouraged as a means to resolve problems quickly.

Within this structure, a large amount of individual work was conducted by taking ownership of Word documents containing sub-sections of the course for around 1-3 weeks, before passing it back to the group for review. Application sharing was used to work through these drafts in online meetings. While providing an effective structure for working together, the approach did not allow for general awareness of each other's work. The use of wikis or shared document editors was not considered appropriate, as it did not fit with existing production processes in the organisations, and would have required additional learning.

Consistency was considered an essential, but difficult, quality to maintain. Changes result in a cascade effect where large amounts of work become required to make sure the same terminology is used, or that a concept is not moved or removed, then later used without explanation. While the course had a modular structure of units and pages, and successful open materials such as Kahn Academy adopt a modular approach, this is not equivalent to the way that parts of object-orientated code can be isolated and worked upon without consequences for others. In some cases, it was decided that changes would not be made because of the work this would entail. A process of Learning Design Analysis [6] was employed at C, initially to summarise the courses and highlight opportunities for changes, and later to see the effect of changes, and find inconsistencies. However, this is a time consuming and somewhat subjective process.

The choices of systems used represented a negotiation between organisations, based in existing procedures and expertise. The remixed work was hosted on a system at C, and documents were shared through a repository hosted at A. A gateway website was hosted by A. Production work occurred at A, B and C. Various communications channels, including web conferencing, conference calls, and email, were used. Technical knowledge sharing occurred through consistent interactions between teams at A, B and C. Concern was expressed that a key staff member at A was employed temporarily, so this knowledge could be lost.

Adaptive and Creative Forms of Remixing

The study skills course became approximately 9,000 words shorter through its remix process, to a total of around 45,000 words. With less time and resources, the content expert and editor focused almost entirely on replacing or removing examples and language that was seen as too culturally-specific to the UK. We define this as *'Adaptive Remixing'*. In contrast, the mathematics course became approximately 10,000 words longer, reaching a total size of almost 92,000 words. Entirely new interactive elements were created, and a large number of images and videos were added from the web. There was a large expansion of material around fractions to fit the US educational culture. Structural changes were also made: two of the eight units that made up the course were split, becoming four. We define this as *'Creative Remixing'*, as these activities go beyond simple translations of the original material.

Breaking this down, a more complex picture emerges: The first half of the course and the final section were the subject of most attention, and grew by more than 20,000 words. While the original intention was to treat the whole course equally, the effort of Creative Remixing was greater than anticipated, and these sections were considered in less need of modification. In a heated discussion over these issues, a project leader noted that the content was originally of high quality, so the project would never be putting out *"wrong"* materials, only materials with less *"additional polish"*. In the end, these sections were subject to Adaptive Remixing.

Shared Meaning-Making and Original and New Audiences

Each person brought a part of the required knowledge to the group, who engaged in building shared understanding by identifying distinctions and similarities between the original and intended audiences. The need to *"clarify who we are targeting"* was repeatedly pressed in early meetings. Team members in the US were experienced in the needs of their classes, while those from C had experience of creating and teaching with the original version. A valuable role for members from C was to explain reasoning behind the original design of the mathematics course. In further remix work, it has been decided to engage an original author of the study skills course in a similar way.

Figure 1: Tracked changes in remixing documents, showing Adaptive Remixing practices in the study skills course (above), and adding of new activities with external images in Creative Remixing of the mathematics course (below).

Members of the remixing team were deeply unwilling to publish anything that they did not see as their best possible work. This appears in contrast to the culture of releasing alpha or beta products, common in OSS. Team members explained that this was part of the empathetic processes through which they worked, which could be considered analogous to a user-centred approach in computing. One noted that *"you know the fact that it's difficult to 'get' maths online, and you know …(creating the right materials) takes time to do"*. Another states that the *"important angle (to view from) is as the student who is seeing it for the first time, and that is critical in maintaining the instructional integrity,…consistency both in tone and in the actual instructional processes"*. Developing a shared understanding of the audience was the dominating theme of early discussions. Later, discussions revolved around how a learner of this type would respond to given examples.

Designing Open Online Learning

Whereas the course materials were originally designed for use in conjunction with consistent tutor support, a content expert from B stated that the remix was designed *"to stand on its own, in a way that students could…be interested and stimulated by the content, without requiring a tutor, although admittedly I think a tutor would add value"*. A further theme throughout the project was therefore how to improve the value of the course independent of tuition. One response was to develop a set of Pencasts. This was considered time-consuming but rewarding, as it allowed the important or difficult parts of a concept to be emphasized in a way that was difficult through text. The design of interactive elements overlaps strongly with pedagogical concerns. For example, some team members were deeply concerned that quizzes could create disillusionment if struggling students were given feedback showing failure. Because of this, they were not emphasised in the course structure, and effort was made to present them as optional.

Encouraged by the open approach, extensive time was taken to collect material from the web to integrate with the course. This was either directly embedded or links were provided as supplemental work. However, a review team member argued successfully in an early meeting that too much *"exuberance"* in adding content would be detrimental. It was agreed that this was a particular problem as large quantities of external content – videos, games or other instructional web sites - could be easily found and it could *"become a habit"* to keep including more of them.

Although external resources can appear low in cost, they raise further ownership issues. A member of the technical team noted that they are *"not owned by anyone on the team"* and owners *"can remove them at any time they want….and that'll appear in our units until someone catches it"*. An external web-based calculator was also adopted with the aim of providing a consistent basis for examples. However as the materials were finalised, aesthetic changes were made to the calculator, so screenshots became outdated. Several team members noted in later interviews that they would like to replace videos and the calculator with internally-owned versions, to avoid coping with changes to external resources. A further complication was that adding media such as videos, or even equations, required following accessibility standards and creating transcriptions, to honour the initiative's aim to make content accessible to all. For external resources this was often missing, and it was not feasible to take this work on in all cases. Thus, openness can present both opportunities or, without care, further digital divides.

Overall, the remixing process and outcomes were considered a great success. At the same time, an open project always offers the opportunity to do more, and further, smaller remix iterations have since occurred with both courses. Results were achieved because many of those involved gave more to the project than they had originally intended. This investment occurred because a sense of ownership between organisations developed in the process.

Reusing

At least 16 institutions have adopted and used the remixed OER. These include large campus colleges, distance learning universities, and charity-funded organisations helping underserved populations. Over 8000 unique visitors have been identified. Although registration is not required for basic use, over 1100 users have registered as of November 2012, allowing them to take quizzes and see their progress. Interest has spread beyond the US, with organisations in India piloting use of the resources, in order to assess whether they should produce their own remix.

Contextualisation across Diverse Organisations

As with many novel ventures, the act of making an OER available is not enough in itself. Practices around encouraging and supporting reuse by organisations and individuals are seen to be essential to the project's success. Gaining awareness and buy-in from institutions, and providing support at early stages are found to be essential. In this case, a dedicated project manager and several other US-based team members spent extensive time developing links with other organisations, and commonly visited them as they introduced the materials into their courses. While the resources are free, employee time is not, and training and a small stipend were given where deemed necessary.

The resources have found use across diverse organisations and instruction types, with a mixture of face to face, distanced and hybrid use in classes. Others have targeted students based on their track record or other data, and pointed them to the materials as a supplement. In college settings where courses are run in semesters, there has been particular interest in providing the materials to students in the period between them showing an interest or registering for a course, and their course beginning. These *'Contextualisation'* practices, where the resources are not altered, but are used in innovative ways, are significant. In

most cases their impact was considered highly positive, but it also raises complex issues. One college experimented with compulsory assignments based on activities in the study skills course, as part of induction for a whole cohort of new students. Some of whom found this inappropriate, as it did not take their prior experience into account.

On finding a desire for the resources outside of colleges, the project diversified to working with organisations such as high schools and charities. Here computer access and skills could be major issues. The project manager at C noted that *"a lot of them may not have a computer at home, or if they do, they may not have the internet at home so they have to go to a school or library…not only do they have to be committed to doing the work but they have to physically go somewhere else"*. Digital literacy was also a barrier, but there is evidence that by providing an appropriate computer-based resource, the project acted as a catalyst. The director of a centre for at-risk parents, which took on both courses as part of college preparation classes, noted that *"the program is helping to sharpen their computer skills, and giving them an additional learning tool"*.

In light of this, contextualisation practices around OER should connect with initiatives to provide the digital literacy needed for learning online. Hybrid teaching practices combining face to face instruction with opportunities to access open materials on computers are important: Given access to a computer lab and shown the resources by an instructor to prepare for an entry test for a program for the long-term unemployed, one learner noted that: *"I'm not a computer literate person, I always dealt with things hands-on, its paper and pencil… I came out of school in (19)88. To learn online, it's a challenge … but if I can get a little bit of classroom time and computer time, that helps me with my computer skills... without missing anything"*.

Wrapping the Resources for Specific Learners

Using the OER in each instance of use required further planning and thought, taking account of other resources, existing activities and course structures, and constraints on time available. This is a common activity for teachers, but the OER offered new possibilities and disruptions to practice. Instructors commonly picked subsections of the materials to use. In one case where the study skills course was used in conjunction with a textbook, the instructor knew of significant overlap, but was unsure as to how to deal with this. In other cases, classes took place in computer labs where listening to audio was either not possible or inappropriate, so transcripts were used to replace videos.

Through these examples, we see an opportunity for better support for this practice of '*Wrapping'* OER to instructors immediate needs. Practical constraints on time and expertise means that rather than making significant changes to the materials as in remixing, instructors need support to tailor their presentation for a specific class. This includes providing additional instructions or activities, making explicit connections between different resources, highlighting important sections, hiding others, and adjusting the use of media to their particular environment. This needs to be achieved in a low cost manner that does not require extensive training. In this way OER can support the creativity of the instructor in lesson planning and execution.

DISCUSSION

In table 2, we define the practices found in our analysis of remixing and reuse. We suggest analogies between these and practices in OSS and CBPP, but in all cases there are important distinctions. We summarise our findings below:

Collaboration styles around openness are strongly linked to the product form and pre-existing conditions in a domain. Rather than taking a form consistent with OSS or CBPP, we find OER practices to require more tightly-coupled collaboration. OER shows some similarities in planning and discussion with findings on film 'collabs', OSS UI development, and open hardware. There is also a spectrum of ways in which openness links with organisations: CBPP is often focused on individual contributions, OSS combines work by individuals and organisations, while OER has been embedded in organisations from its inception.

Openness as a social and legal concept legitimises reuse formally in the creation of new outcomes, which leads to new notions of ownership. Openness provides firm ground for appropriating existing products across organisations. This is leading to new forms of 'ownership', taken by organisations and individuals that did not originally create the OER. In all of the identified practices, the sense of taking ownership could be considered an integral factor in the motivations and decisions made. Remixing work created a strong sense of ownership, characterised by the sense of responsibility as team members had their *"names on the project"*. Contextualisation and Wrapping do not involve remixing the OER directly, but still provide scope to collaborate and take ownership of the OER through creativity. This develops as organisations and individuals take a resource into their own use, decide where and how it can be beneficial, place trust in it, adjust practices, and potentially become influential in its future direction.

Openness at a technical level is supported by the ability to replicate without cost, which has understood benefits in supporting sharing and modification, but also problematic issues that re-emerge when using the concept in a different domain. Concepts that aid OSS development, such as versioning, bug reporting or modularisation, are not directly portable to other open practices. In OER, characteristics such as consistency are more complex and less easily defined than those in code, and can impose large costs on creative remixing. Even if parts of a learning resource can be considered modular, they cannot be as easily modified independently of a whole, without consequence. In Bridge to Success, reusing resources that the team did not own (e.g. the calculator) was a problematic endeavour.

Practice:	Creative Remixing	Adaptive Remixing	Contextualisation	Wrapping
Description:	Finding scope to create additional materials, and to integrate external materials to create a new version.	Identifying problems with use in new context, editing or deleting content in response.	Identifying means to integrate use of materials with current organisational practices, needs and strategies.	Identifying parts of the resources to reuse. Planning and providing instructions for a group.
Transformation:	Expansion in size	Contraction in size	Organisational integration	Integration with learners
Concerns:	Understanding original and (broad) new audience, exuberance in adding.	Understanding original and (broad) new audience, consistency.	Fit to organisation aims and learners needs. Tackling digital divides. Evaluating approach taken.	Fit to specific context, considering overlap with other materials
Requirements:	Extensive time and resources. Knowledge of audience. Ability to change structure, add interactive elements and integrate external resources.	Some time and resources, knowledge of audience, basic ability to edit and republish materials.	Knowledge of ways in which materials can be used. Organisational buy-in. Knowledge of learners and their needs.	Knowledge of the materials and specific audience. Ability to present the desired subset of the materials effectively.
Analogies in OSS and CBPP:	Adding new features, changing UI, adding new content or structure.	Porting code to other platforms, bug fixing, minor edits or updates.	Using OSS as part of a business model or service.	Appropriating and using OSS. Reusing sections of content.

Table 2: Practices identified in OER remixing and reuse

Intra-organisational systems and processes are both starting points and tensions to open inter-organisational collaborations. Organisations have a desire to open their own tools and systems up to use with collaborators, but this creates overheads in developing approaches to work. The project team used various repositories, web spaces, learning management systems and software tools, with most controlled by one of the organisations. This created a variety of overheads, and a lack of understanding affected remixing progress, even when training was planned. There was however a sense within the project that using each other's processes and tools would be beneficial. Further complexity emerged in assessing different forms of reuse, as organisations collect different forms of data on students, and have barriers to openly sharing this. The "institutional dimensions of collaboration readiness" that Luo et al. suggests are required for OER should include: Capabilities for integrating in-house data, systems and processes with those of other institutions; An understanding of how each of the four practices defined in table 2 could be beneficial; and a means to staff build competencies in these practices.

Having a strong conception of the original and intended audiences is essential to remixing and reusing OER, but expect to go beyond this. Remixers spent extensive time exploring the original aims of the materials, and in OER, understanding an author's reasoning appears somewhat analogous to source code in OSS, though approaches to supporting this need to be sensitive to the subjectivity inherent in less technical domains. Practices around OER for a developmental audience can be distinguished from those for independent learners, and the approach in this project was distinct from MOOCs, which rely on independence and digital literacies. In addition, the materials have been used by more diverse groups than was intended. This is perceived as both a great success and a challenge. Low-effort support for contextualisation and wrapping could extend the reach of resources.

Barriers to reuse practices in education have similarities to those in other domains, including demands on digital literacy and the availability of training and support to ease transitions to use. The broad and growing range of uses of these materials can be attributed to three factors – addressing a common problem where resources were lacking, a large investment in remixing an already tried and tested resource, and significant energy put into building awareness and building cross-organisational ties around reuse. This final factor is where open practices often appear lacking, as although there is often a logical argument for open resources, support is needed to seed a culture of reuse.

CONCLUSIONS

As Openness spreads, it is becoming intertwined with multiple domains and organisational practices. Although more traditional OSS and CBPP processes continue to thrive, a broader understanding of openness as a set of socio-technical practices needs to be developed in HCI. In this paper we have analysed a form of cross-organisational collaboration and open practice in education that is considered as a growing success story. Remixing and reusing OER - while not without difficulties at this early stage in its development - resulted in useful outcomes, shared learning, cross-cultural creativity and cross-

fertilisation of processes and systems. Further support and development of the practices detailed here should aid the growth of openness in education and beyond.

ACKNOWLEDGMENTS

Bridge to Success was funded by an NGLC grant, a program led by EDUCAUSE. The Bill and Melinda Gates and William and Flora Hewlett Foundations helped design and fund the initiative. This work was also supported by RCUK through the Horizon Digital Economy Research grant (EP/G065802/1). We would like to thank the project team, and instructors and students who gave us their time.

REFERENCES

1. Atkins, D. E., Seely Brown, J., Hammond, A. L., A Review of the Open Educational Resources Movement: Achievements, Challenges and New Opportunities, hewlett.org/uploads/files/Hewlett_OER_report.pdf
2. Cheliotis, G. & Yew, J. An Analysis of the Social Structure of Remix Culture, Communities & Technologies '09, (2009). ACM Press. 165-174.
3. Conole, G., 2011, Defining Open Educational Practices (OEP), http://e4innovation.com/?p=373
4. Crowston, K., Wei, K., Howison, J., & Wiggins, A., Free/Libre open-source software development: what we know and what we do not know. ACM Comput. Surv. 44, 2, 7 (2012). ACM Press.
5. Diakopoulos, N., Luther, K., Medynskiy, Y. & Essa, I., The Evolution of Authorship in a Remix Society, Proc. Hypertext and Hypermedia (2007). ACM Press. 133-136.
6. Open University Learning Design Initiative, http://www.open.ac.uk/blogs/OULDI/
7. Gutwin, C., Penner, R. & Schneider, K., Group Awareness in Distributed Software Development, Proc. CSCW '04 (2004). ACM Press. 72-81.
8. Kolowich, S., Who Takes MOOCs?, http://www.insidehighered.com/news/2012/06/05/early-demographic-data-hints-what-type-student-takes-mooc
9. Kop, R., The Challenges to Connectivist Learning on Open Online Networks: Learning Experiences during a Massive Open Online Course. *International Review of Research in Open and Distance Learning 12:3* (2011).
10. Lessig, L., The Future of Ideas: The fate of the commons in a connected world, (2001) Random House.
11. Lovett, M., Meyer, O. & Thile, C., The Open Learning Initiative: Measuring the Effectiveness of the OLI Statistics Course in Accelerating Student Learning, *Journal of Interactive Media in Education* (2008).
12. Luo, A., Ng'ambi, D. & Hanss, T., Towards Building a Productive, Scalable and Sustainable Collaboration Model for Open Educational Resources, *Proc. of GROUP* (2010), ACM Press. 273-282.
13. Luther, K., Caine, K., Ziegler, K. & Bruckman, A., Why It Works (When It Works): Success Factors in Online Creative Collaboration, *Proc. of GROUP* (2010), ACM Press. 1-10.
14. McAndrew, P., Defining openness: updating the concept of "open" for a connected world, *Journal of Interactive Media in Education* (2010).
15. Mellis, D. A. & Buechley, L., Collaboration in open-source hardware: third-party variations on the arduino duemilanove, *Proc. of CSCW* (2012), ACM Press. 1175-1178.
16. Mellis, D. A. & Buechley, L., Scaffolding Creativity with Open Source Hardware, *Proc. of Creativity & Cognition* (2011), ACM Press. 373-374.
17. Microsoft: Openness, www.microsoft.com/en-us/openness/
18. Moghaddam, R. Z., Bailey, B. P. & Fu, W., Consensus Building in Open Source User Interface Design Discussions, *Proc. CHI* (2012). ACM Press. 1491-1500.
19. Mozilla, Open Badges, https://wiki.mozilla.org/Badges
20. Open Knowledge Foundation, Open Definition, http://opendefinition.org/
21. Rollandson, B., Bergquist, M. & Ljungberg, J., Open Source in the Firm: Opening up professional practices of software development, *Research Policy 40* Elsevier, (2011). 576-587.
22. Sarmiento, J. W. & Stahl, G., Group Creativity in Virtual Math Teams: Interaction Mechanisms for Referencing, Bridging and Remembering, *Proc. of Creativity and Cognition* (2007) ACM Press, 37-44.
23. Sawyer, R. K., Explaining Creativity (2006). Oxford University Press.
24. Stokes, P., Creativity from Constraints: The Psychology of Breakthrough (2005), Springer Press.
25. Petrides, L., Jimes, C., Middleton-Detzner, C., Walling, J. & Weiss, S., Open textbook adoption and use: implications for teachers and learners. *Open Learning 26:1* (2011). Taylor and Francis. 39-49.
26. Vertesi, J. & Dourish, P., The Value of Data: Considering the Context of Production in Data Economies, *Proc. CSCW* (2011). ACM Press. 533-542.
27. Weller, M., The Digital Scholar: How Technology is Transforming Scholarly Practice. (2011). Bloomsbury.
28. Wiley, D., Impediments to Learning Object Reuse and Openness as a Potential Solution, *Revista Brasileira de Informática na Educação, 17: 3* (2009). 8-10.
29. Yamauchi, Y., Yokozawa, M., Shinohara, T. & Ishida, T., Collaboration with Lean Media: How Open-Source Software Succeeds, *Proc. CSCW* (2000), ACM Press 329-338.